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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
BROOME, SAID A	
ART UNIT	**PAPER NUMBER**
2671	

DATE MAILED: 02/27/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/748,235	MAILLOT, JEROME	
	Examiner	Art Unit	
	Said Broome	2671	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on _31 December 2003_.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _1-34_ is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) _1-17,31 and 34_ is/are allowed.

6)☒ Claim(s) _18,19,21-29,32 and 33_ is/are rejected.

7)☒ Claim(s) _20 and 30_ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Allowable Subject Matter

Claims 1-17, 31 and 34 are allowed.

The following is an examiner's statement of reasons for allowance:

The prior art, Yamrom (US Patent 6,249,287) and Glassner (Spacetime Ray Tracing for Animation), do not teach the limitations of claim 1. Yamrom teaches finding an intersection with an original mesh surface in column 1 lines 46-48. Glassner teaches finding an intersection with the surface of a three dimensional object, as illustrated in Figure 2. Glassner also teaches determining an intersection by using an outer bounding surface on page 61 second column fourth paragraph lines 1-5, a tight inner surface that is both bounded by the outer bounding surface and wraps the original surface of the three dimensional object in Figure 3, and tessellating the bounding region around a three dimensional surface in Figure 2. However, none of the prior art teaches or suggests a first tessellation linking the tight inner surface to the original mesh surface and a second tessellation linking the bounding surface to the tight inner surface, as recited in claim 1.

The prior art, Yamrom and Glassner, do not teach the limitations of claim 31. Yamrom teaches determining an intersection with an original mesh surface in column 1 lines 46-48 and Glassner teaches determining a ray-object intersection by using an outer bounding surface, as described page 61 second column fourth paragraph lines 1-5, and a tight inner surface that is both bounded by the outer bounding surface and wraps the original surface of the three dimensional object in Figure 3. However, none of the prior art teaches or suggests detecting movements of the ray or object one relative to the other, and for some of the movements when

the ray intersects the mesh object at a local neighbor of a face of the mesh object, determining whether intersection of the ray with the mesh object is occluded by the mesh object by traversing polygons not part of the mesh object; and when the ray does not intersect the mesh object at a local neighbor of a face of the mesh object, finding an intersection of the ray with the mesh object by traversing polygons intersected by the ray, where the polygons are not part of the mesh object and include at least one polygon of a bounding surface bounding the mesh object, as recited in claim 31.

The prior art, Yamrom (US Patent 6,249,287) and Glassner (Spacetime Ray Tracing for Animation), do not teach the limitations of claim 34. Yamrom in view of Glassner teach a mesh surface that is provided with a bounding surface bounding the mesh containing a tight inner surface. Glassner also teaches tessellating the bounding region around a three dimensional surface in Figure 2. However, none of the prior art teaches or suggests a first tessellation linking the convex hull to the original mesh surface, and a second tessellation linking the bounding surface to the convex hull, where the second tessellation tessellates a space between the bounding surface and the convex hull surface, and where the first tessellation tessellates a space between the convex hull surface and the original surface mesh; and a processing unit performing at least one of: finding a first intersection between a ray and the original mesh by finding a first intersected polygon or polyhedron of the bounding surface, and then traversing adjacent intersected polygons or polyhedron starting from the first intersection until the intersection is found; and finding a second intersection between the ray and the original mesh when the ray or original mesh have relatively moved, finding a polygon locally neighboring the first intersection and containing a first intersection with the moved ray, and traversing out from

the neighbor polygon through adjacent polygons or polyhedrons intersected by the moved ray, and determining whether traversed polygons or polygons of traversed polyhedrons are unoccluded along ray based on whether they are part of the convex hull surface, as recited in claim 34.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Claim Objections

Claims 20 and 30 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 21 and 32 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Regarding claim 21, it is unclear as to whether the "bounding surface" recited in the claim refers to the bounding surface around the tight inner surface or the outer bounding surface that wraps the original mesh. However, if the claim was intended to refer to an outer bounding surface as recited in claim 19, then the applicant is advised that should claim 19 be found allowable, claim 21 will be objected to under 37 CFR 1.75 as being a substantial duplicate thereof. When two claims in an application are duplicates or else are so close in content that they both cover the same thing, despite a slight difference in wording, it is proper after allowing one claim to object to the other as being a substantial duplicate of the allowed claim. See MPEP § 706.03(k).

Regarding claim 32, it is unclear storage unit recited in the preamble of the claim is a computer-readable media. The examiner provides one suggested correction to overcome this rejection: "A volatile or non-volatile computer-readable media or computer-readable storage unit storing data structure …".

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 18, 19, 21 and 24-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yamrom in view of Glassner.

Regarding claim 18, Yamrom teaches a method of automatically finding an intersection with an original mesh surface in column 1 lines 46-48. Glassner teaches finding an intersection with the surface of a three dimensional object, as illustrated in Figure 2, therefore this intersection method would be capable of determining the intersection with an original mesh surface as well. Glassner also teaches determining an intersection by using an outer bounding surface on page 61 second column fourth paragraph lines 1-5, and a tight inner surface that is both bounded by the outer bounding surface and wraps the original surface of the three dimensional object in Figure 3, therefore a mesh surface of a three dimensional object would also be capable of being wrapped by the outer bounding surface as illustrated in Figures 2 and 3. It would have been obvious to one of ordinary skill in the art to combine the teachings of Yamrom with Glassner because this combination would provide accurate ray-object intersections of objects that are bound by an outer surface, which efficiently provides the visible intersected objects.

Regarding claims 19 and 21, Yamrom teaches determining an intersection with a mesh surface in column 1 lines 46-48. However, Yamrom fails to teach an intersection with the original mesh surface that is performed according to an intersection with the outer bounding surface. Glassner teaches detecting an intersection of an outer bounding surface of a three dimensional surface on page 61 second column fourth paragraph lines 1-5, and it is also illustrated in Figure 3. It would have been obvious to one o ordinary skill in the art to combine the teaches of Yamrom with Glassner because this combination would provide fast detection of intersection of a ray with a mesh surface by bounding the outer surface of a mesh which reduces the complexity of the outer surface enabling simpler detection of intersection.

Regarding claim 24, Yamrom teaches the intersection between a lines and a mesh in column 1 lines 46-48. Yamrom fails to teach determining whether a polyhedron or polygon intersected by the lines contains or is an outermost intersection with line based on whether such polyhedron or polygon is on a convex hull surface of the mesh model. Glassner teaches determining whether a three dimensional object, such as the object illustrated in Figure 2, is intersected by a ray as described on page 61 second column fourth paragraph lines 1-5, in which the polygon is on a convex hull surface of the model as shown in Figure 3. It would have been obvious to one of ordinary skill in the art to combine the teachings of Yamrom with Glassner because this combination would provide accurate detection of the outer surface of a mesh model, which reduces the complexity during determination of ray intersection with an object.

Regarding claim 25, Yamrom teaches traversing the ray to determine the polygons that intersect the line in column 2 lines 52-66, and is also illustrated in Figures 4 and 5.

Regarding claim 26, Yamrom fails to teach traversing to a next polyhedron or polygon when a traversed polyhedron or polygon is inside an interior or convex region of the mesh model. Glassner teaches traversing to a next polygon when a polygon ins inside the convex region bounding the object on page 61 first column fifth paragraph lines 9-11, where it is described that when the ray intersection is within the inner convex surface, the object within must be further checked, which inherently teaches traversing further to the interior of the convex region, as shown in Figure 3. It would have been obvious to one of ordinary skill in the art to combine the teachings of Yamrom with Glassner because this combination would provide accurate determination of ray intersection with object bounded within a convex surface.

Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Yamrom in view of Glassner in further view of Bruderlin et al. (US 2003/0179203).

Regarding claim 22, Yamrom teaches defining an intersection with an original mesh in column 1 lines 46-48 and Glassner teaches the intersection with a bounding surface on page 61 second column fourth paragraph lines 1-5. However, Yamrom and Glassner fail to teach a path that corresponds to polygons or polyhedrons of tessellations that intersect with a line. Bruderlin et al. teaches a path that intersects tessellated triangles in paragraph 0161 lines 1-5, therefore the path of the ray corresponds to the polygons of the tessellations. It would have been obvious to one o ordinary skill in the art to combine the teachings of Yamrom, Glassner and Bruderlin et al. because this combination would provide accurate determinations of where a ray or line intersects the mesh surface along a path of tessellated polygons through the bounding surface that comprises the mesh surface, which generates the detection of the visible portions of the mesh surface through the bounding surface from a path emerging from a particular viewpoint.

Claim 23 is rejected under 35 U.S.C. 103(a) as being unpatentable over NewHall, Jr. (US Patent 6,489,955).

Regarding claim 23, NewHall, Jr. teaches determining an ordered list of polygons that are intersected between a line and a mesh model. Therefore it would have been obvious to one of ordinary skill in the art to modify the teachings of NewHall, Jr. to provide an intersection order or rank of the intersections between lines and a mesh model in order in which the ray intersects the model form a certain viewpoint, as described in column 11 lines 31-41.

Claims 27-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Khan (US 2004/0001110) in view of Reed et al. (US Patent 6,249,600).

Regarding claim 27, Khan illustrates an intersection between a ray and an object in Figure 10A, based on moving the ray, as described in paragraph 0049 lines 1-7. Khan fails to teach that after finding the intersection determining whether the second intersection is occluded along the ray by the mesh object. Reed et al. teaches determining occlusion along array intersecting a mesh model in column 2 lines 16-25 and column 3 lines 38-41. It would have been obvious to one o ordinary skill in the art to combine the teachings of Khan and Reed et al. because this combination would provide precise determination of visible regions of mesh objects using ray intersections.

Regarding claim 28, Khan illustrates in Figure 10C a second intersection 200/202 from ray 196/198 is locally near a first intersection 200 from ray 196.

Regarding claim 29, Khan fails to teach a third intersection that occludes along a ray. Reed et al. teaches finding an intersection that occludes along a ray in column 2 lines 16-25 and column 3 lines 38-41. The motivation to combine the teachings of Khan and Reed et al. is equivalent to the motivation of claim 27.

Claims 32 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Suzuki et al. (Subdivision Surface Fitting to a Range of Points).

Regarding claim 32, Suzuki et al. teaches a bounding mesh or box, as described on page 4 section 4.1 second paragraph lines 1-4 continuing in the second column lines 1-8, bounding an original mesh surface with a low resolution relative to the original mesh surface, as shown in

Figures 6A and B. Suzuki et al. also teaches a mesh of polyhedrons constrained to the original mesh surface and constrained to the original mesh, where polyhedrons with shared faces generally decrease in size in the direction of the original mesh surface, which is shown in Figure 13 as the polyhedrons constrained to the mesh are further subdivided from the bounding box to the original mesh surface, the size of the polyhedrons are shown to decrease in size in the direction of the original mesh surface. Regarding claim 33, Suzuki et al. teaches the collection of data points comprised on the mesh surface are contain ed in an octree data structure, as described on page 4 section 4.2 first paragraph lines 4-5, and constrained to a bounding surface as illustrated in Figure 6. It would have been obvious to one of ordinary skill in the art to modify the teachings of Suzuki et al. because these teachings would provide efficient subdivision of shared faces of a mesh surface that it contained in a bounding surface and then further tessellated in the direction of the mesh thereby displaying a high resolution mesh surface.

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The other references listed on the attached PTO-892 form are made of record because they pertain to ray object intersection.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Said Broome whose telephone number is (571)272-2931. The examiner can normally be reached on 8:30am-5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ulka Chauhan can be reached on (571)272-7782. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

S. Broome
2/16/06 SB

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SUPERVISORY PATENT EXAMINER